N64-25731

Letters

Code none

Cat 12

Densities Obtained from Drag on the Explorer 17 Satellite

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Orbit elements for the active experiment lifetime of the satellite Explorer 17 have been obtained and utilized in the determination of atmospheric density in the region of the perigee of the satellite. The differential corrections, using minitrack interferometer data, covering data arcs of approximately seven days, were carried out by personnel of the Data Systems Division of the Goddard Space Flight Center. Table 1 contains the orbital data.

Figure 1 shows density versus a converted local solar time. The angle between vectors from the center of the earth to perigee and to the sun (zenith angle) has been converted to an equivalent local solar time for comparison with the *Harris and Priester* [1962] model atmosphere. The density determinations were made by utilizing the formulas of *King-Hele* [1960]. These formulas give the density one-half scale

height above the perigee height and require an assumed scale height for calculation. The scale height assumed was 30 km, and hence the densities given are to be associated with an altitude of 270 km. An over-all confidence bound of ± 10 per cent could be applied to each data point. The data are plotted as obtained and also with an adjustment for the 27-day variation of density with solar 10.7-cm flux. The adjustment is made because the Harris-Priester model does not include this short-period effect. The data are adjusted to a flux number of 84, the mean value over the three-month period. A first power law was used and the resultant data can be compared to the Harris-Preister model with an S number of 100. The solid line on the figure is the Harris-Preister model curve for $S = 100$.

In Figure 2 the abscissa is the local solar time at perigee. The solid curve is an interpolated

TABLE 1. Orbital Elements

| Epoch	a, km	e	i	ω	Ω	h_x, km	h (apogee), km
4/3/63	6964.06	0.04745	1.00576	0.85205	2.14429	255.4	916.4
4/9/63	6963.04	0.04729	1.00574	1.01720	1.73179	255.6	914.2
4/14/63	6962.15	0.04727	1.00584	1.15656	1.38772	254.9	913.1
4/20/63	6961.07	0.04717	1.00581	1.32190	0.97491	254.6	911.3
4/25/63	6960.24	0.04705	1.00585	1.46048	0.63067	254.6	909.5
4/30/63	6959.47	0.04698	1.00583	1.59877	0.28622	254.4	908.2
5/5/63	6958.45	0.04686	1.00586	1.73677	6.22491	254.2	906.4
5/11/63	6957.17	0.04663	1.00586	1.90377	5.81117	254.6	903.5
5/16/63	6956.03	0.04650	1.00577	2.04219	5.46629	254.4	901.2
5/21/63	6954.88	0.04628	1.00586	2.18050	5.12104	254.9	898.6
5/28/63	6953.60	0.04614	1.00576	2.37446	4.63770	254.6	896.3
6/4/63	6952.20	0.04587	1.00582	2.56775	4.15386	255.1	892.9
6/11/63	6950.92	0.04675	1.00572	2.76361	3.66989	256.7	890.3
6/18/63	6949.90	0.04545	1.00580	2.95754	3.18557	255.8	887.6
6/24/63	6949.27	0.04534	1.00576	3.12654	2.77033	256.0	886.2
6/30/63	6948.63	0.04525	1.00577	3.29326	2.35505	256.0	884.9
7/6/63	6948.12	0.04508	1.00578	3.46145	1.93952	256.7	883.2
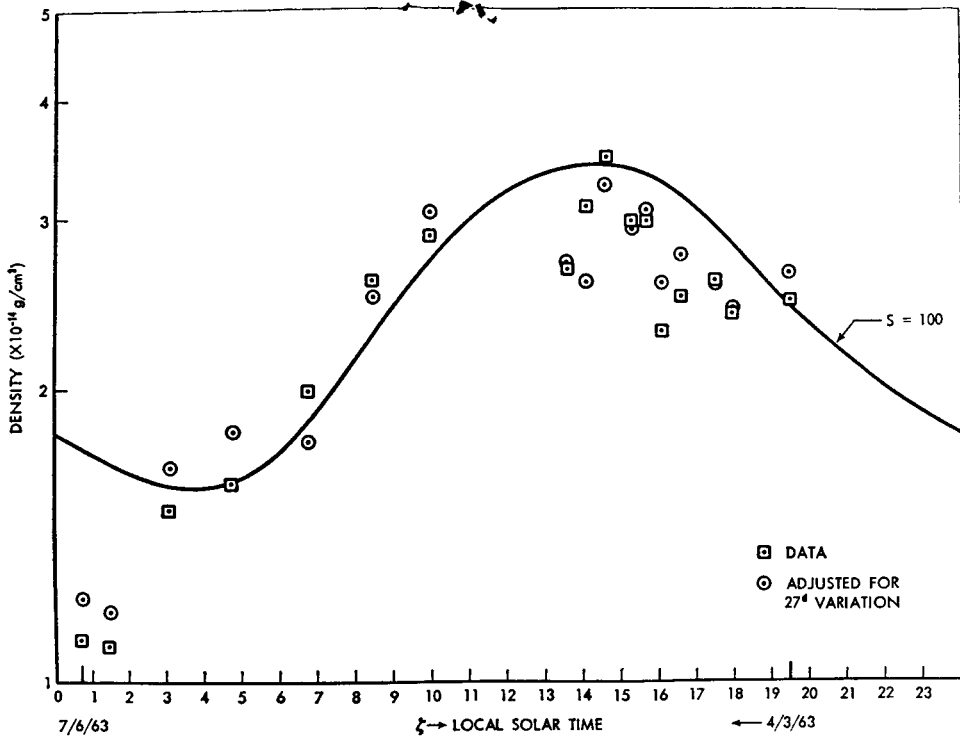
Fig. 1. Density versus converted zenith angle.
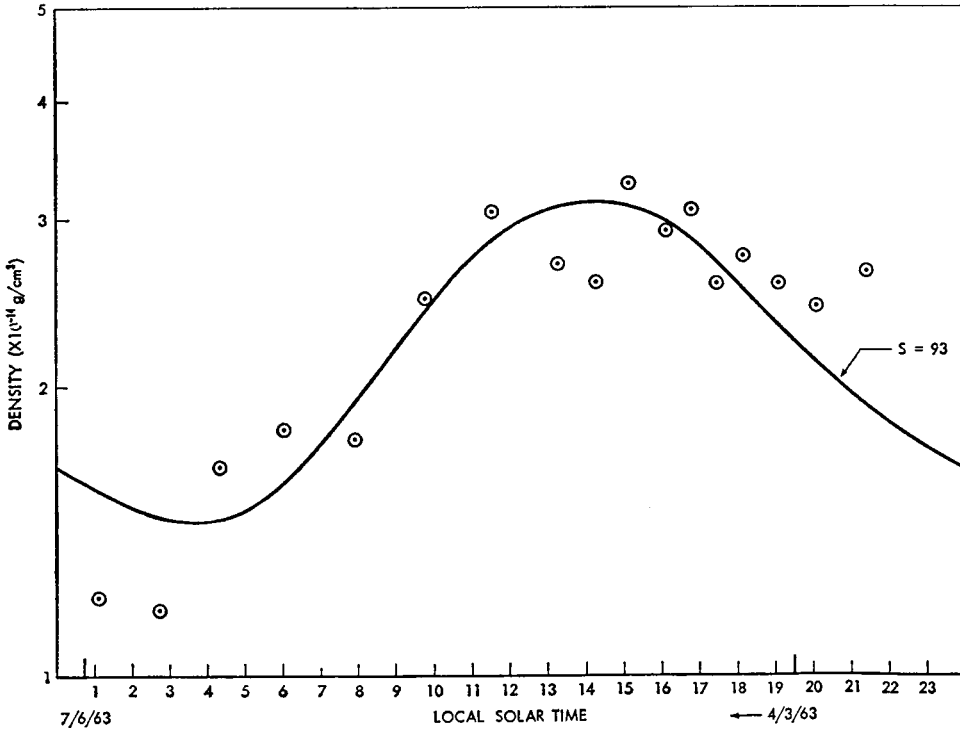
Fig. 2. Density versus local solar time.

TABLE 2. Basic Data

Epoch	$\dot{p}$	$\rho(h_\pi + H/2)$	$\rho(270)$	LST_π	δ_π	$\delta_\pi - \delta_\bullet$	ζ	$\bar{F}$
4/3/63	−0.2118	2.48×10^{-14}	2.67×10^{-14}	21.5	+39.5	34.5	123.8	78
4/9/63	−0.2054	2.40×10^{-14}	2.44×10^{-14}	20.2	+45.9	38.7	106.6	82
4/14/63	−0.2236	2.61×10^{-14}	2.58×10^{-14}	19.2	+50.6	41.5	94.3	85
4/20/63	−0.2107	2.46×10^{-14}	2.76×10^{-14}	18.2	+54.9	43.7	82.7	75
4/25/63	−0.1968	2.29×10^{-14}	2.58×10^{-14}	17.5	+57.1	44.2	75.1	75
4/30/63	−0.2551	2.97×10^{-14}	3.08×10^{-14}	16.9	+57.6	43.1	68.6	81
5/5/63	−0.2595	3.02×10^{-14}	2.95×10^{-14}	16.2	+56.4	40.4	61.7	86
5/11/63	−0.2997	3.48×10^{-14}	3.28×10^{-14}	15.2	+53.0	35.3	51.5	89
5/16/63	−0.2680	3.11×10^{-14}	2.69×10^{-14}	14.3	+48.8	29.9	40.9	97
5/21/63	−0.2316	2.68×10^{-14}	2.72×10^{-14}	13.3	+43.8	23.8	28.5	85
5/28/63	−0.2529	2.93×10^{-14}	3.07×10^{-14}	11.6	+35.9	14.6	15.4	80
6/4/63	−0.2297	2.65×10^{-14}	2.50×10^{-14}	9.8	+27.3	5.0	29.7	89
6/11/63	−0.1727	1.99×10^{-14}	1.78×10^{-14}	8.0	+18.2	−4.9	56.2	94
6/18/63	−0.1414	1.63×10^{-14}	1.81×10^{-14}	6.1	+8.9	−14.5	85.5	76
6/24/63	−0.1270	1.46×10^{-14}	1.66×10^{-14}	4.4	+0.7	−22.7	111.4	74
6/30/63	−0.0941	1.08×10^{-14}	1.18×10^{-14}	2.8	−7.3	−30.6	137.3	77
7/6/63	−0.0957	1.10×10^{-14}	1.21×10^{-14}	1.1	−15.4	−38.2	162.6	76

Harris-Priester model curve adjusted to fit the data and resulting in an approximate S number of 93.

The two figures are presented because the actual shape of the diurnal bulge is still not known. The first figure places the functional dependence on an angle between perigee and the sun and the second on the local solar time.

On both figures the time covered is indicated by the dates at the bottom. The first epoch is April 4, 1963, and the last, July 6, 1963.

Information useful for further study of the shape of the diurnal bulge is given in Table 2. Tabulated in order are: Epoch, rate of change or period in seconds per day, density at one-half scale height above perigee height, adjusted density at 270 km, local solar time at perigee, declinantion of perigee, difference in declination between perigee and the sun, zenith angle, and average 10.7-cm solar flux for the data arc.

REFERENCES

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